Low-level precipitation sublimation on the coasts of East Antarctica

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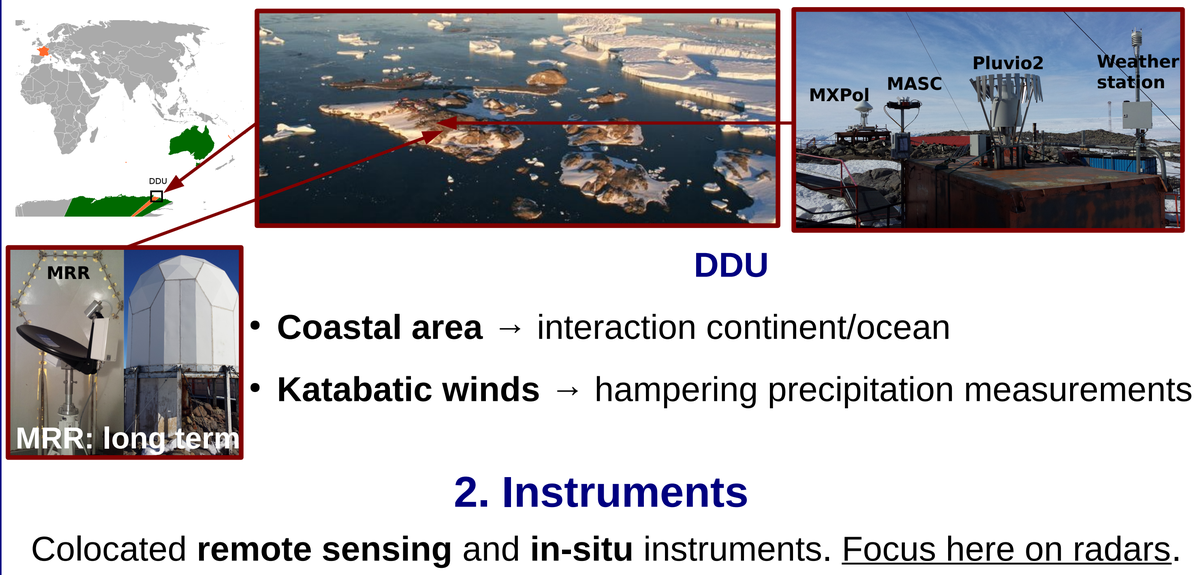
1. Project APRES3

Antarctic **P**recipitation, **RE**mote **S**ensing from **S**urface and **S**pace is a project aiming to obtain field **observations of precipitation** in Antarctica and to evaluate the potential of remote sensing for large scale monitoring.

First field campaign: Dumont d'Urville (Nov 2015 – Feb 2016)



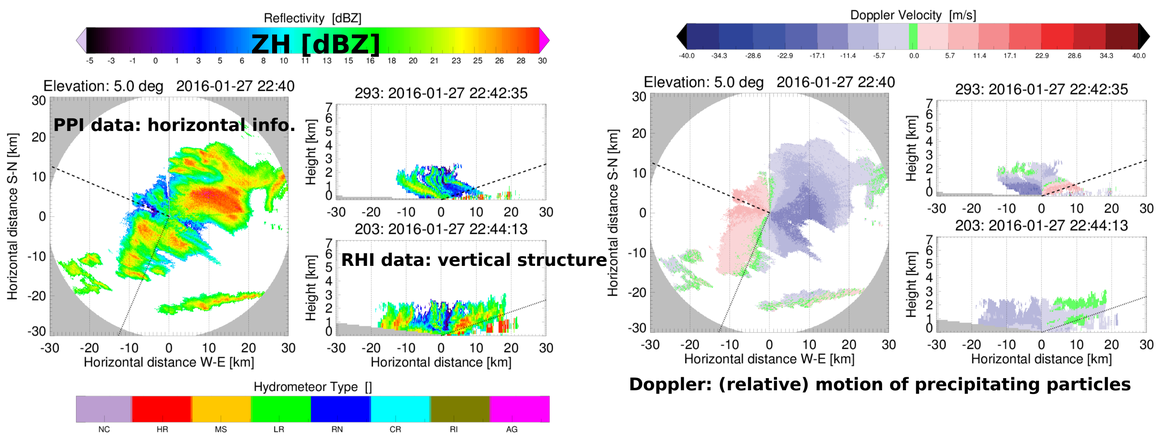
DDU

- **Coastal area** → interaction continent/ocean
- **Katabatic winds** → hampering precipitation measurements

2. Instruments

Colocated **remote sensing** and **in-situ** instruments. Focus here on radars.

MXPol: X-band dual-polarization scanning Doppler radar

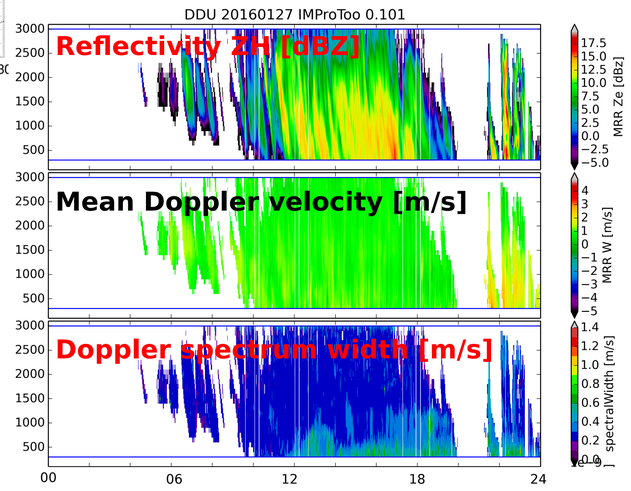


Hydrometeor classification

Doppler: (relative) motion of precipitating particles

MRR: K-band vertical profiler (still deployed at DDU)

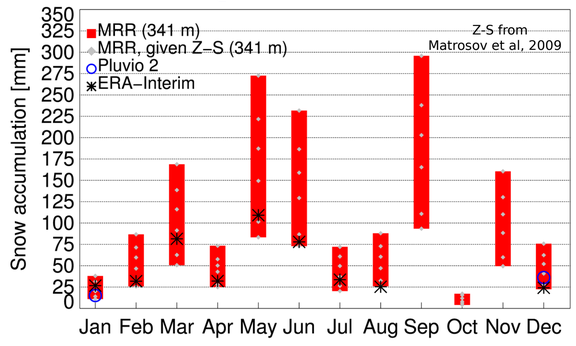
vertical + time precipitation structure
unknown radome attenuation →
Comparison/calibration with MXPol



- Information on **3D storm structure**
- Precipitation **microphysics** (polarimetry)
- Turbulence + PSD (**spectrum width**)
- Discrimination: precip / virga

3. One year of precipitation statistics

Quantification

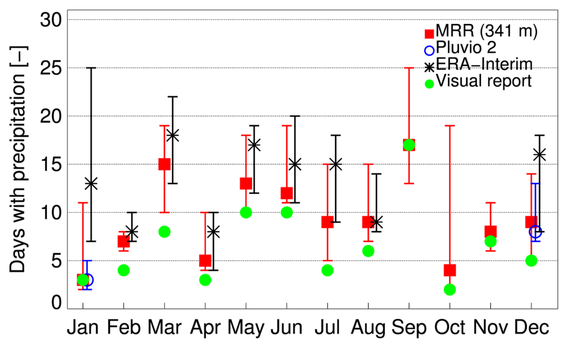


Large spread due to different Z-S

Seasonality: dry summer / "wet" winter

ERA-Interim: within MRR estimates

Occurrence



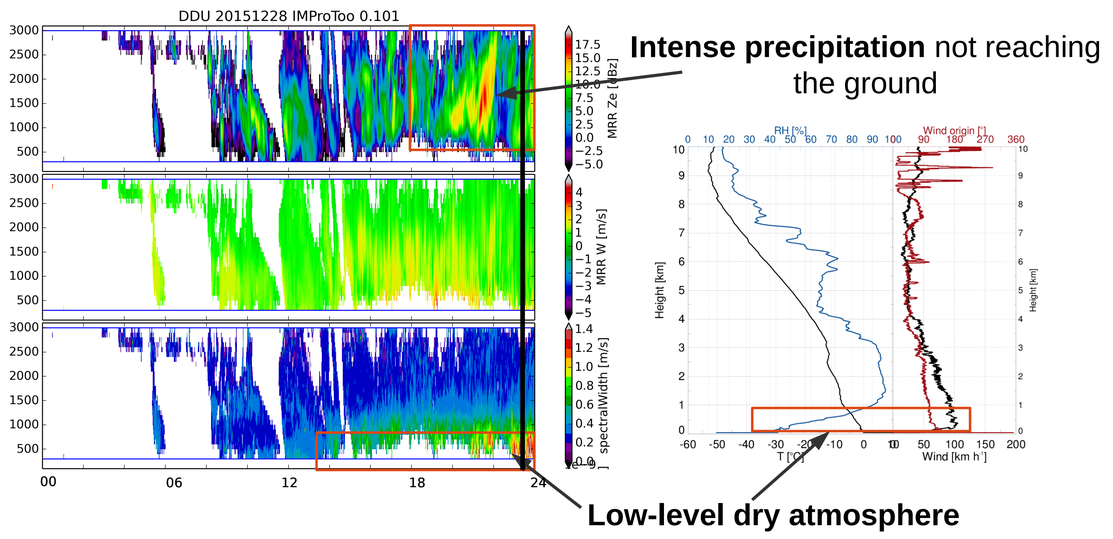
ERA-Interim**: overestimation**
(particularly during dry months)

Visual observations: u**nderestimation**
(discontinuous, affected by visibility)

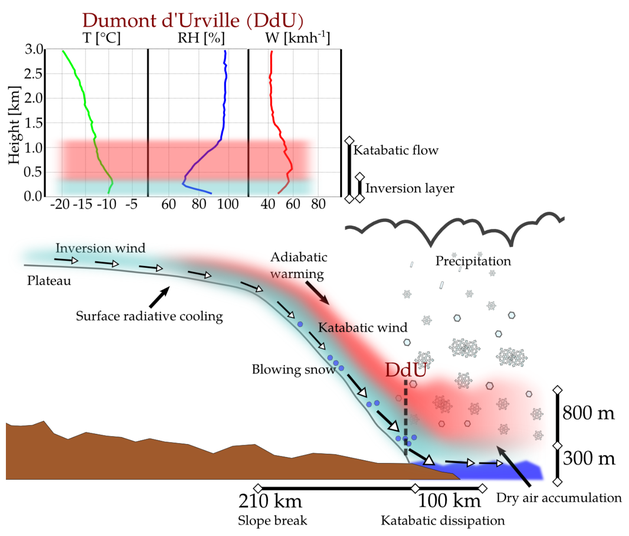
3. Low-level sublimation

Katabatic winds (and in general, cold and dry air coming from the continent) create a low-level dry layer → **enhanced sublimation**

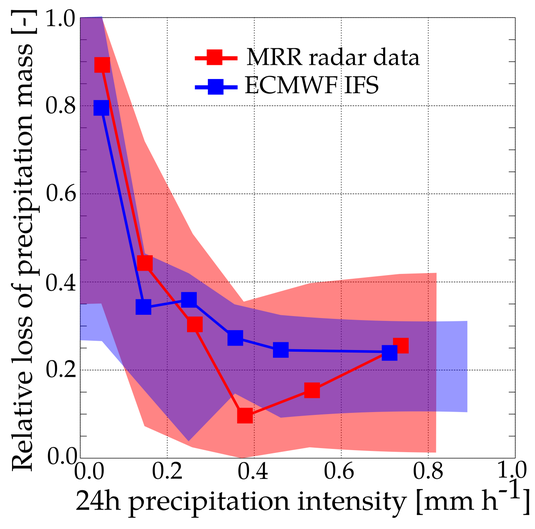
Example: low level sublimation (MRR and radiosounding)



Conceptual model

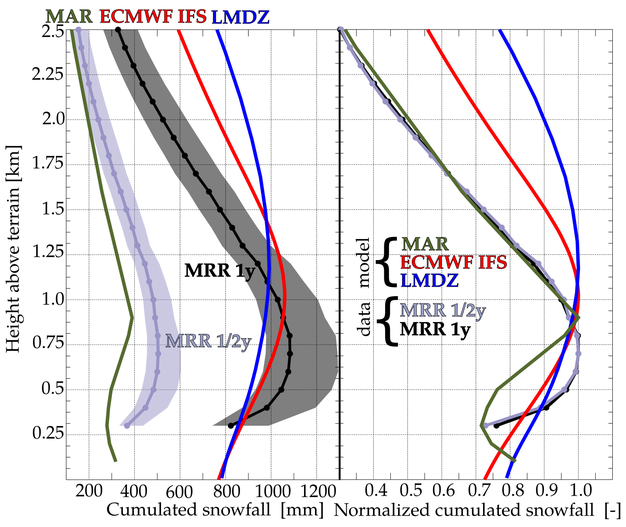


Influence of intensity



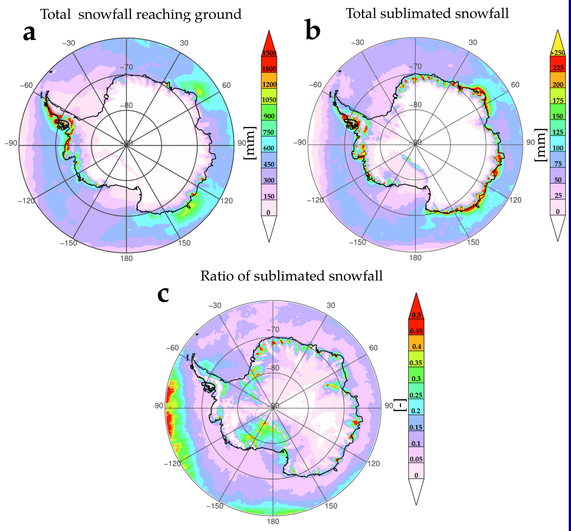
Do atm models reproduce this sublimation?

MAR (polar RCM, 5 km) , ECMWF IFS (GCM, 10 km)
LMDZ (GCM, 70 km)



Models get the general shape OK, not the amplitude and altitude of peak, at DDU.

Over Antarctica



Sublimation in low levels is significant:
17% of total precip over East Antarctica
35% over regions below 1 km altitude.

Limitation: near ground precipitation (MRR) is ~340m above ground level

4. Conclusions and perspectives

- The 1st campaign of the project APRES3 shows the potential of advanced instruments (**remote sensing**) to study precipitation in Antarctica.

- Radar observations and atm models are used to show that katabatic winds strongly sublimates snowfall over the Antarctic the margins.

Ongoing work is also focused on:

- Evaluate **NWP simulated** snowfall accumulations.
- Evaluate **satellite**-based retrievals (i.e. **Cloudsat**).
- Provide medium-long term records of precipitation measurements.

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http://lte.epfl.ch

APRES3

apres3.osug.fr

Grazioli, J. et al., Measurements of precipitation in Dumont d'Urville, Terre Adélie, East Antarctica.The Cryosphere Discuss. 2017, 1–23 (2017). http://www.the-cryosphere-discuss.net/tc-2017-18/

The MRR images have been realized with the IMProToo code described in:
Maahn, **M**. and **Kollias, P**.: Improved Micro Rain Radar snow measurements using Doppler spectra post-processing, *Atmos. Meas. Tech.*, 5, 2661-2673, doi:10.5194/amt-5-2661-2012, 2012.

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